

SOILS OF THE UPPER VALLEYS OF THE MURRAY RIVER BASIN

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ABSTRACT: The landscapes and soils of the valleys of the Upper Murray River and its main tributaries in New South Wales and Victoria are described.

These areas have a complex topography which comprises a low central, clearly terraced alluvial belt, a higher multi-stepped gently sloping fringe of more or less dissected alluvial-colluvial fans, and broadly rounded spurs, ridges and hills. At their outer edges, the valley slopes grade up sharply to the steeper slopes of the confining ranges.

Studies of the relationships between soils and landscape features have been assisted by the use of a conceptual framework of soil-geomorphic units, referred to as 'pedo-morpholiths'.

Soils of the flood-plain are usually stratified and undifferentiated, whereas on slightly older bodies of sediment the soils are weakly differentiated, and may have gradational profiles. The most widespread soils on the older, upper terraces and fans and the less steep residual hills are red and yellow duplex soils. Gradational soils are also well represented in these areas in a range of situations which indicate they are of different ages. A common feature of this area of older land forms is that surface soils are often found to overlie truncated remnants of older soils.

In areas where average annual rainfall is above about 650 mm, the soils are typically quite acid and free of lime. In the drier areas however, free lime may occur in the subsoil.

Because the soils of the alluvial-colluvial landscapes are generally deep, and occur in areas of relatively high and reliable rainfall, they are widely used for agricultural production.

INTRODUCTION

This paper describes the soils and valley landscapes of the Upper Murray River and its main tributaries, the Swampy Plains and Tooma Rivers in New South Wales and the Mitta Mitta, Kiewa and Ovens Rivers in Victoria. (Fig. 1).

FACTORS AFFECTING THE SOILS

Soil characteristics and the distribution of the different soils are dependent upon the nature of the material in which the soils are formed, the topographic setting, the climate over the period of soil formation and the length of time that the material has been exposed to the biological and physical processes which have operated. To understand the differences between the soils and their distribution it is necessary to know something about these factors.

Within the area under consideration, the present-day rainfall ranges from about 500 mm in the

relatively dry, warm areas in the west to about 1000 mm in the cooler higher rainfall areas in the sheltered upper valleys in the east and south.

The rocks from which the soil parent materials are derived include granodiorite, granite and Palaeozoic non-calcareous sedimentary rocks, much of which have been metamorphosed to gneiss or schist. Most of the soil parent materials in the valley landscapes are transported and occur as fans and terraces, and even on hill-slopes there is commonly a mantle of colluviated material. The stratigraphic relationships of these bodies of sediment allow relative age sequences to be identified.

THE GEOMORPHIC SETTING

In cross-section each valley landscape shows a characteristic sequence of topographic units, schematically shown in Fig. 2A. The broad, low-relief valley plains of smaller stream systems which

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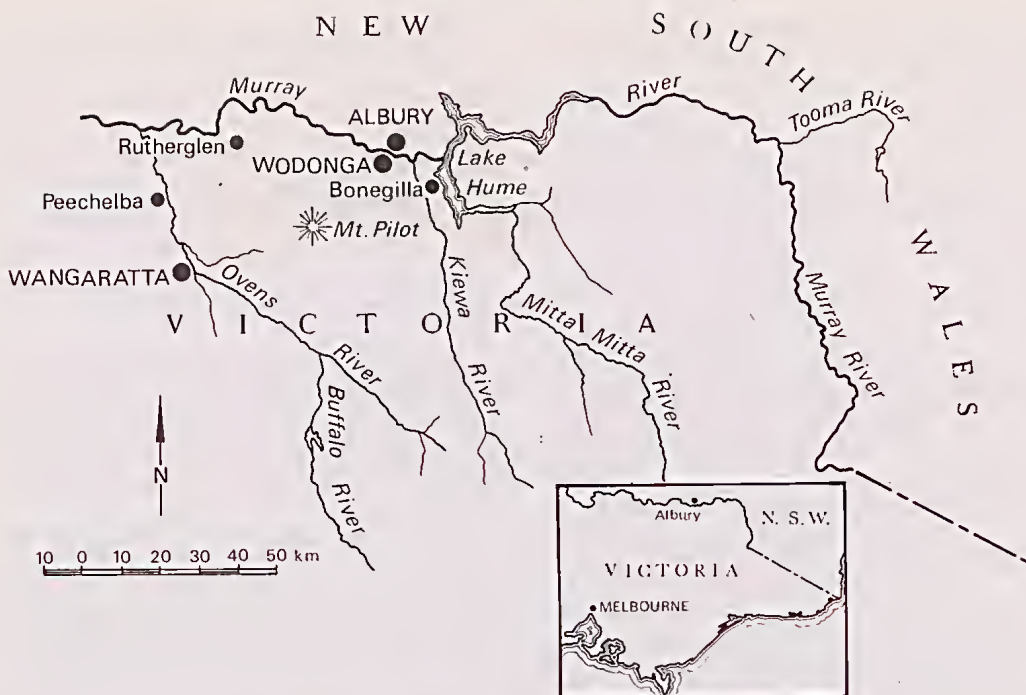


FIG. 1 — Location plan.

characterize in particular the country north of Albury show the same sequence, although the topographic units occur in different proportions. The latter sequence is shown in Figure 2B.

All the major valleys and many of the tributary streams have flood plains which are regularly flooded and still receive regular accessions of sediment.

A flood plain is usually dissected by abandoned meander channels which in many cases retain water for much or all of the year. There may also be sandy levees associated with the present stream channel and some of the abandoned channels. A feature of the flood plain is that the channels of tributary streams are often located on its outer edge for some distance before entering the trunk stream. These features influence the distribution and character of the flood plain soils.

The flood plains are bordered by a set of alluvial terraces, the lower two of which may be well represented although their respective proportions vary considerably in any one valley. In some areas small benches of stream alluvium are found at even higher levels on the valley sides. The area around Bonegilla — Hume Weir, where the Mitta Mitta and Kiewa Rivers meet the Murray, has several such high level alluvial deposits.

Extensive terraces some 10-15 m above the entrenched flood plain and low terrace set are a

prominent feature of the lower Kiewa valley, the Murray valley west of Albury and the Ovens valley below Wangaratta where they form extensive valley plains. Remnants of another terrace below the extensive valley plain, but well above the low terrace set, occur intermittently. A good example of this terrace is traversed by the Hume Highway for several hundred metres immediately east of the Reedy Creek bridge at Wangaratta North.

The extensive valley plain of the Ovens to the north-east of Wangaratta has a well formed prior stream system (Butler *et al.* 1973) which is readily identified on aerial photographs. A section of the prior stream channel, Wim Creek, still carries local drainage. A short section of a similar (or the same) prior stream system occurs to the west of Wangaratta, and other remnants can be identified upstream towards Tarrawingee and at Millawa. Butler *et al.* (1973) mapped another extensive prior stream system extending to the northwest of Corowa. Remnants of this system can be recognised as far east as Howlong.

Flanking the prior stream ridges on the Ovens are poorly drained clay plains which, to the north and east of Boorhaman, are quite extensive. The main prior stream system to the northeast of the Ovens loses its identity in a series of more-or-less parallel, sandy ridges which extend from Boorhaman north through to Brimin on the Murray near

its confluence with the Ovens. These appear to be an ancient dune system derived from sediment deposited at the confluence of these two major valleys.

In the mid to lower reaches of the main valleys, much of the less steep landscape within the confining ridges consists of complex fans of alluvium and colluvium. In broad valleys such as the Mitta Mitta at Noorongong and the Kiewa at Dederang, and near the junction of the Tooma with the Murray, the alluvial fan landscape constitutes a large proportion of the valley. As the valleys narrow upstream, a smaller proportion of the alluvial fan landscape persists, until in the upper reaches it is common for the flood plain and terrace landscape to abut directly onto the steep slopes of the valley sides where bedrock outcrops or is covered by a thin mantle of colluvium. Young colluvial fans may be present at the foot of the steep slopes.

The uppermost members of the alluvial fan sequence are well dissected, and fan-in-fan forms are common (Pl. 13, above). The toes of these older fans have, in most cases been truncated by the trunk stream (Pl. 13, below), which results in a more or less continuous irregular scarp some 5 to

10 m high at the outer edge of the lower alluvial terrace set. This feature is well developed along much of the Kiewa valley and in the Mitta Mitta valley. Valley-side drainage systems which traverse the fan landscape, have dissected the scarp and young fans extend onto the upper members of the lower terrace set. The main components of the landscape are shown in Fig. 3.

THE SEQUENCE OF EROSION, DEPOSITION AND SOIL FORMATION

The relationship between the present soils and the geomorphic history has been examined by van Dijk and Rowe (unpubl.), and a conceptual framework of the sequence of erosion and deposition and soil formation developed. The approach requires a detailed consideration of land form, the nature of the sedimentary material and the soil and deep sub-solum features. Distinctive soil-geomorphic units have been referred to as *pedo-morpholiths*. The concept assumes that bodies of material transported at similar times have undergone similar weathering processes over similar periods, so that when lithologic, local topographic and regional climatic effects are allowed for, the pedogenetic and other weathering

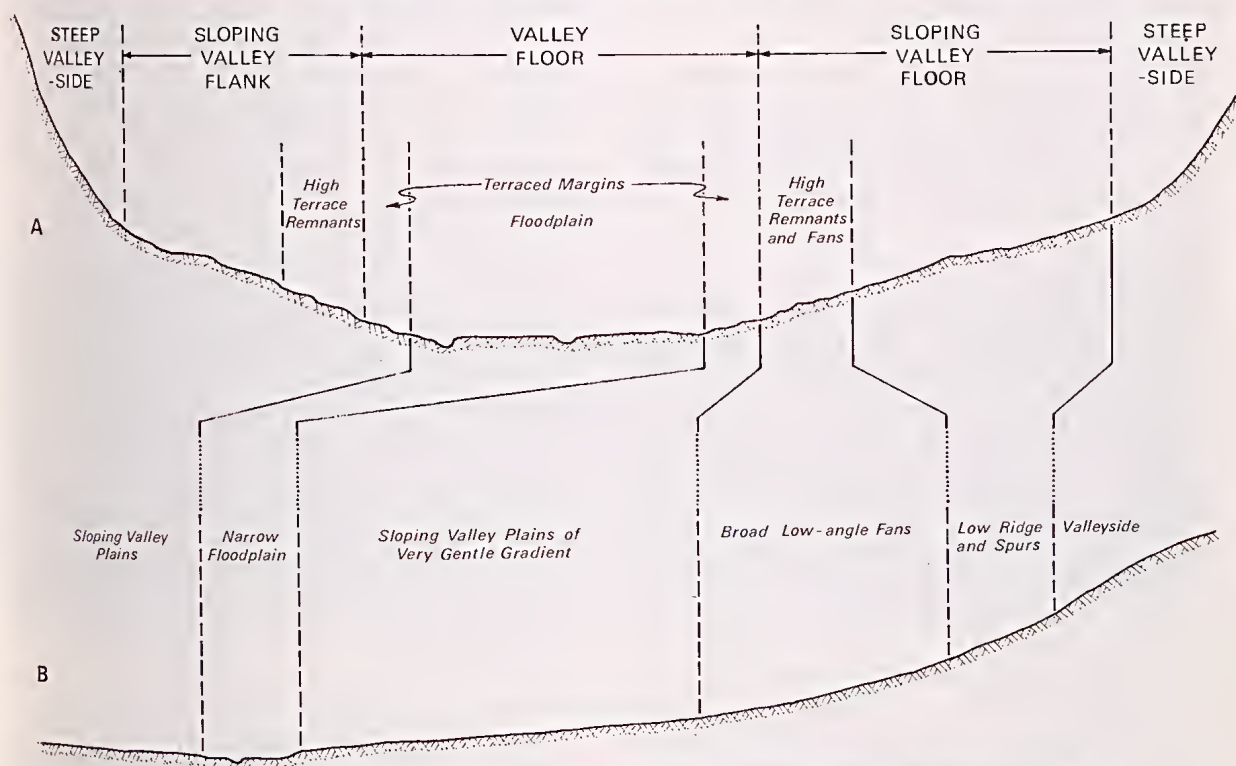


FIG. 2 — Schematic cross-sections of valley landscapes. A. Major valley of the highlands; B. Valley of the foothills.

features of such similar-aged bodies should have certain features in common. The approach is an attempt to enhance the predictive value of detailed landscape analysis for soil mapping.

The sets of terraces and the fan-in-fan formations indicate that periodic alternation between landscape erosion and subsequent stability plus soil formation has played a dominant role in developing the present valley landscapes. The agencies responsible for the periodic landscape instability have been changes in climatic patterns as proposed by Butler (1959) or regional tectonic activity which altered regional erosional base-levels.

Successive periods of erosion and deposition have modified the older landscapes to varying degrees, but the characteristics of the sequences of depositional bodies that exist in these valleys indicate that the general trend has been for each successive period of erosion to be less severe. As a consequence of the long history of periodic erosion, many of the older bodies of sediment have been greatly modified, and the more highly weathered and readily eroded materials have been truncated or in places, have presumably been stripped entirely.

This geomorphic evidence for periodic events in landscape formation is complemented by the widespread occurrence of buried soils.

Although the complexity of the present surface soil pattern is still difficult to interpret in detail, an understanding of the sequence of soil and landscape-forming events as provided by the pedo-morpholith framework helps substantially in extrapolating soil mapping from limited detailed site studies.

THE SOIL PATTERNS

Some general relationships are shown in Table 1 with reference to Fig. 3 to indicate zones which are identified with major stages in pedo-morpholith development.

There is a general trend from the youngest soils with minimal pedogenic alteration through increasing development of colour, texture and structure in B horizons in the soils on older materials. However, the trend does not persist to the oldest materials, where some of the soils have distinctly duplex profiles whereas others are gradational. The effects of surface stripping and burial may be evident in some of these duplex soils, and stone-lines, which can be interpreted as lag-layers formed by soil movement, sometimes mark the junction of the A- and B- horizons and may sometimes occur within the A-horizon.

There is a trend towards increased thickness of

the B-horizon with increasing age but this can be upset where substantial stripping of the old soil has occurred, or when the original mantle of weathered material was shallow.

Within a specific landscape component, catenary effects occur. When moving from upper catenary positions to lower ones, such effects are, typically, changes from reddish to yellowish sub-soil colours, increased sub-soil mottling and sometimes development of ironstone concretions in soils in low situations.

The effect of climate is probably most evident in the changing soil reaction trends, as the most acid soils occur in the higher rainfall areas of the east, and soils with free lime in the subsoil are mainly found in the drier western areas. However, the present average annual rainfall over most of the area is above 650 mm and leaching of salts and free ions predominates over accumulation except in topographic low areas where drainage is impeded.

PREVIOUS SOIL STUDIES

Much of the knowledge of the soils and their distribution in the area has been derived from broad-scale land-system studies by Rowe (1967, 1972 and unpublished data) on the Victorian side of the Murray. Newell (1970) made a detailed study of the soils of the alluvial landscapes in the central part of the Ovens valley between Wangaratta and Bright and in the Buffalo River. Except for the work of Newell, the wider valley landscape of the Ovens north of Whorouly has not been systematically examined. Crouch (1976) described soil associations and dominant soil groups on the Albury district. His work has been supplemented by localised detailed surveys around Albury and Howlong (Junor *et al.* 1977, Junor & Crouch 1977).

THE MAIN SOIL GROUPS

The primary profile forms of Northcote (1974) provide a convenient grouping of the soils on the basis of whether texture profiles are uniform, gradational or duplex. Organic soils, the fourth primary profile form of Northcote, occur in the alpine areas of the region, and do not occur in the area described in this paper. The names used for the soil groups are adapted from the Northcote primary profile forms to provide a descriptive nomenclature.

1. SOILS OF UNIFORM TEXTURE

1.1 *Alluvial Soils.* These are the soils of the flood plains, and youngest terraces and alluvial fans throughout the Upper Murray. As they are formed on the youngest alluvium and lack biological

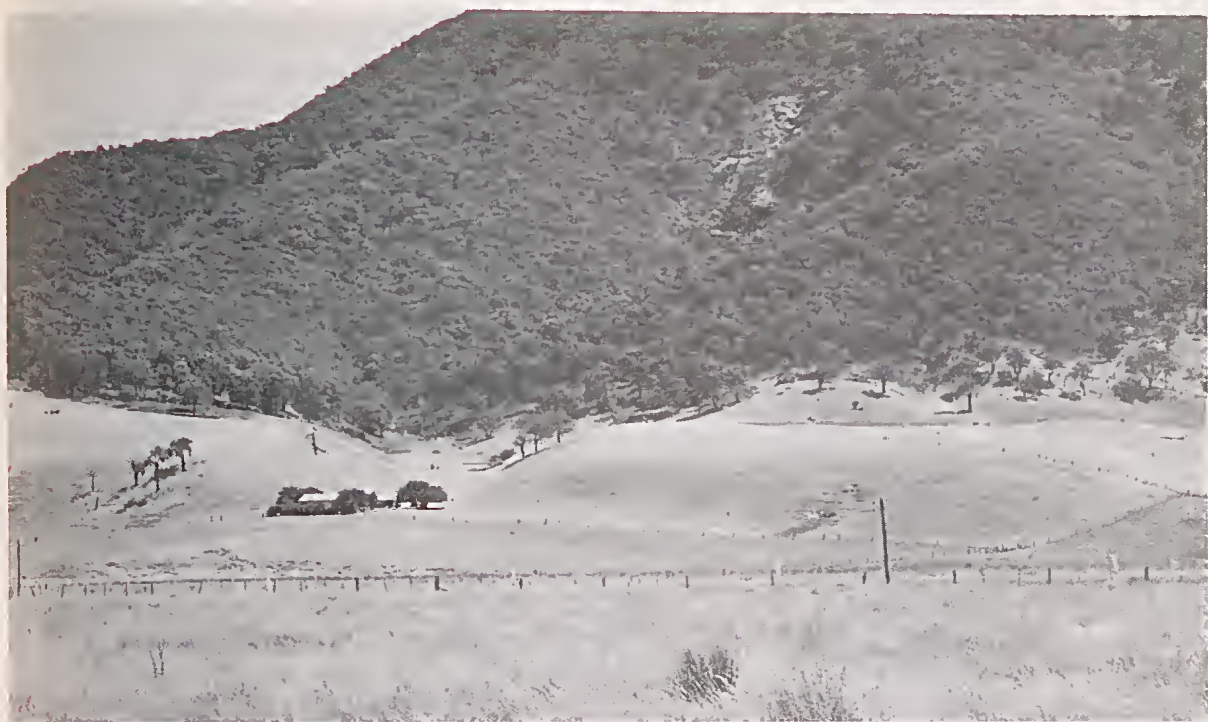


PLATE 13

(Above) The Mitta Mitta valley at Noorongong, showing a broad terrace in the foreground and fan-in-fan forms at the foot of the steep valley sides.

(Below) The lower valley of the Kiewa River. The older alluvial fans have been truncated and dissected. Younger fans emerge from the entrenched drainage lines and grade down to the upper member of the lower terrace set.

TABLE 1
THE BROAD PATTERNS OF SOIL AND LANDSCAPE RELATIONSHIPS.
(To be read in conjunction with Fig. 3.)

<i>Soil Group</i>	<i>Main Land- scape Zone</i>	<i>Distribution</i>
1. <i>Soils of Uniform Texture</i>		
1.1 Alluvial soils	F-F F-D	Predominant on floodplain On youngest fans
1.2 Sandy loams	D-E	On young fans and hillwash sheets from coarse-grained rocks
1.3 Grey and brown clays	C-D E-G	On slope mantle and fans Common on poorly-drained parts of high terraces or valley plain
1.4 Brown loams	F-F	On terrace remnants just above flood plain
2. <i>Gradational Soils</i>		
2.1 Reddish gradational soils		
.1 Soils with minimal B-horizon	E-F D-E	On lower terrace remnants in this zone and occasional fans which overlie the upper terraces On fans; more extensive in upper valley tracts
.2 Soils with well developed B-horizon (friable)	B-E	On older fans, high terrace remnants in upper valley tracks and deeply weathered old surface remnants
Soils with well developed B-horizon (firm)	B-C	Mainly on high benches and convex upper surfaces of old land forms
2.2 Yellowish brown gradational soils	F-F D-F	Extensive on upper terrace in this zone Common on relatively young fans
2.3 Massive gradational soils	D-E C-D	Widespread on concave valley fills On slope mantles and fans; also on well weathered in-situ bedrock
3. <i>Duplex Soils</i>		
3.1 Non-calcareous reddish duplex soils (earthy peds)	E-F D-E	On the mid terrace in this zone On valley slopes and large, low- gradient fans
Non-calcareous reddish duplex soils (shiny peds)	B-D	Extensive on dissected older fan landscape of main valleys, on high terrace remnants and convex upper surfaces with well weathered bedrock
3.2 Calcareous reddish duplex	E-G	In the north-west on high terrace or valley plain, and prior stream ridges
3.3 Yellowish duplex soils with well developed B-horizon	E-G D-E	On poorly drained high terrace On old, low-gradient fans
Yellowish duplex soils with moderate B-horizon development	D-E	Common on valley-fill and poorly drained terraces

mixing, they are often stratified, with beds of differing texture producing variations which do not fit the Northcote key. They are included in this general group because pedogenetic differentiation has not occurred, the main post-depositional development being the accumulation of organic matter in the surface 10 cm or more. Loams and finer textured soils, and particularly those inundated frequently usually have iron-oxide stains in root channels and other voids.

Surface textures vary considerably, reflecting the velocity of the water from which they were deposited. Thus, sandy loams tend to predominate in the upper reaches of the flood plain, loams tend to predominate in the middle reaches and clay loams and clays are the most widespread soils in the lower reaches, such as downstream from Albury on the Murray River and downstream from Wangaratta on the Ovens River.

Low levels of sandy loam or loamy sand may occur, mainly in the middle tracts of the main valleys, for example on the Kiewa at Tangambalanga and the Mitta Mitta at Noorongong.

These soils are usually referred to as alluvial soils (Rowe 1967, 1972), and Crouch (unpublished) has made two subdivisions, light alluvium and grey clays on alluvium. The group includes soils mapped as the Porepunkah, Myrtleford, and Wangaratta Series by Newell (1970).

1.2 Sandy Loams. Sandy loams occur on the coarse sandy sediment derived from granite, granodiorite and gneissic rocks. They are present both as shallow soils on the valley sides and as deeper soils on thick alluvial outwash fans and valley fills. Their occurrence is extensive in areas to the east and northeast of Albury, and to a lesser extent to the south of the Murray in the Thologolong area. They are also common in the broad basin-like valleys at the foot of the Barambog — Mt. Pilot uplands and the Warby Ranges. Older clays may be found at depth.

The texture profile is typically uniform, but may tend towards gradational. Because of the dominance of coarse siliceous sand in the profile, textures are predominantly sandy and where a slight increase in clay has occurred, it may not be apparent in field texturing.

A typical sandy loam would have a greyish brown sandy loam A-horizon with only weakly developed structure. The A2-horizon would be of similar texture but bleached and lacking in structure. The gradual change to the pale brown or mottled yellowish brown B-horizon may occur at depths from 25 to 50 cm. The texture may vary from sandy loam to clayey sand, and coarse weakly developed structure may be apparent, although apedal B-horizons are more usual.

These soils are of low fertility and have low water

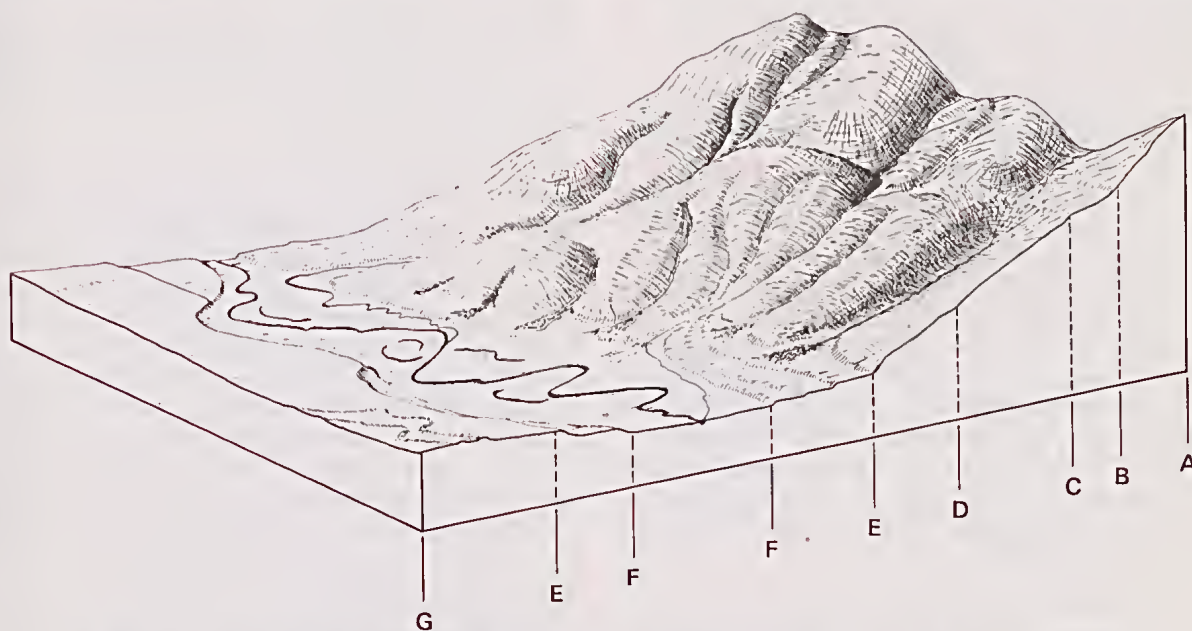


FIG. 3 — Generalised landscape diagram showing soil-geomorphic zones. A-B, steep valley side; B-C, valley side bench; C-D, sloping valley flank; D-E, alluvial fans-piedmont; E-F, terraces; F-F, flood plain; E-G, high terrace, valley-plain; including prior stream relicts.

holding capacity. They tend to be highly dispersible and set hard when dry. Deep gullies are common in them, both in natural drainage lines and where drainage is concentrated by earthworks.

1.3 *Grey and Brown Clays*. Soils of this group are dominant in swampy areas to the west of Albury and on the plains around Howlong and Rutherglen. They extend into the lower Ovens valley around Boorhaman and Peechelba East where they are associated with the prior-stream system on the extensive valley plain.

The grey and brown clays have a silty clay A-horizon which has a moderate crumb to subangular blocky structure. The colour becomes yellower or greyer and the clay becomes heavier with depth. Structure in the B-horizon is well developed blocky to subangular blocky and aggregates up to 10 to 15 cm across are common. Free lime is usually present in the subsoil.

These soils commonly have gilgai micro-relief. Although relatively fertile, they are not usually used for cropping because of seasonal water-logging. The clays have high shrink-swell capacity and surface cracking occurs as the soils dry out. The group has been described by Crouch and Junor (1976).

1.4 *Brown Loams*. These occur on terrace remnants just above normal flood levels or on higher parts of the flood plain, particularly in the middle to upper reaches of the main streams. They are well represented in the Ovens and Buffalo River valleys above Myrtleford and in the Kiewa valley around Tawonga and Dederang.

They are dark grey brown to very dark brown and highly structured in the surface 15 to 30 cm, but the structure declines and the colour pales with increasing depth. River gravel is usually present within a metre of the surface in the upper valleys, but deeper soils occur in lower reaches. In these latter areas the surface soil is greyer and iron oxide straining of root channels is usual; there may also be subsoil gleying. This form is more common in the lower reaches such as in the Kiewa valley at Bonegilla. Soils included in this group have been described as alluvial brown earths and meadow soils (Rowe 1967). The Ovens Series of Newell (1970) is included. The brown loams are moderately fertile soils which are used for summer crops including tobacco.

2. GRADATIONAL SOILS

2.1 *Reddish Gradational Soils*. Two main groups with reddish gradational profiles can be recognised.

2.1.1. *Soils with minimal B-horizon*. Soils of this

group occur on remnants of a terrace above the reach of normal flooding and on alluvial fans which may overlie older fans. These fans sometimes grade down to the terrace surface. The distribution is very discontinuous. The group is well represented around Whorouly, Porepunkah and Bright on terraces and fans, and in the Kiewa valley.

A characteristic profile would have a dark brown sandy loam to fine sandy loam at the surface, gradually changing through yellowish red sandy loam to reddish brown or strong brown sandy clay loam at about 50 cm. Below a weakly developed colour and texture B-horizon about 25 cm thick, the texture grades back to sandy loam.

In upper valley areas such as at Tawonga in the Kiewa valley, river gravel underlies the soil at about 1-1½ m. The structure is only weakly developed in both the A- and B-horizons.

The soils are relatively fertile and are used for pasture and for summer crops, as water for irrigation is usually available from nearby streams or from groundwater. In the Upper Ovens and Buffalo valleys these soils are used for tobacco growing. They have been recognized by Rowe (1972) as reddish gradational soils on alluvium, and the Merriang and Eurobin Series and two unnamed series mapped by Newell (1970) are included.

2.1.2. *Soils with well developed B-horizon*. Two forms of reddish gradational soils with well developed B-horizons can be recognized. In one, the B-horizon is friable and only moderately structured with earthy ped fabric. In the other the B-horizon is strongly structured, peds have smooth faces and moist consistency is firm.

In general, soils of this group have a dark brown loamy A1-horizon over a yellowish red or reddish brown loam to clay loam A2-horizon which merges into the dark red or reddish brown light clay B-horizon. The A-horizon is about 20 cm thick and is moderately structured at the surface but weakly structured to apedal in the A2-horizon.

In the upper valleys, the soils with friable light clay B-horizons occur on older fans and upper terraces, and are common on the steeper slopes such as on the dissected old land surface which has been mapped as the Yackandandah land system (Rowe 1972). They are well represented in the upper Kiewa valley around Tawonga and in the upper Mitta Mitta valley south of Eskdale.

The form with firm B-horizon clays occurs on the gently sloping upper surfaces of the oldest fans and old surfaces such as the Stanley plateau and in the Yackandandah land system. In both forms, the depth of the profile may be in excess of 2 m and is

largely influenced by the thickness of the body of sediment or the depth of rock weathering. They are acid to very acid soils and of moderate to low fertility. The two forms have been described by Rowe (1972) but both are included in the amphipodsol group of Rowe (1967).

2.2 Yellowish Brown Gradational Soils. These are the predominant soils on what is usually the lowest extensive terrace in the Kiewa and Ovens valleys. They are particularly well represented around Wangaratta. Typically, they have a dark greyish brown or dark brown fine sandy loam to fine sandy clay loam A-horizon, and a slightly heavier textured, yellowish brown B-horizon. There may be a slightly bleached A2-horizon and there is usually weak 1 cm subangular blocky structure in the B-horizon. The maximum development of colour, texture and structure in the B-horizon occurs between about 40 to 80 cm, below which pedogenetic development declines.

They are moderately fertile soils and have an acid to weakly alkaline reaction trend. They are used for pastures and in some areas for summer crops, as water for irrigation is usually readily available.

2.3 Massive Gradational Soils. The most extensive areas of these soils in the valley landscape are on concave surfaces of valley fills between low convex slopes of older fans and low hills. Where stream incision has occurred these areas appear as terraces. These soils are also common on fans at the base of the steeper hills and in the slope mantles which may be of colluvial material or in-situ well-weathered rock.

A typical profile is not readily defined, as the group includes a range of rather variable soils, but all have in common a gradual increase in texture from loam or sandy loam in the A-horizon to clay loam, sandy clay loam or sandy light clay in the B-horizon, and except for the surface few cm which have a moderate structure, they are massive and set hard when dry. Colours range from dark greyish brown in the A1-horizon, through yellowish brown or pale brown in the A2-horizon to brown, yellowish brown or yellowish red in the B-horizon. The colour and texture changes are gradual but may not coincide. Gleyed profiles are common and ironstone concretions are also common in profiles with impeded drainage.

They are of relatively low fertility and moderately acid throughout, and are highly erodible. It is possible that these soils are the gradational form of the sandy loams, the latter being associated with coarser textured parent materials. The leptopodzols of Rowe (1967) and the massive reddish

and brownish gradational soils (Rowe 1972) are included in this group.

3. DUPLEX SOILS

3.1 Non-calcareous Reddish Duplex Soils. These are the most widespread soils of the valley slopes and older terraces and fans in the lower valleys of the Mitta Mitta and Kiewa Rivers and the mid-valley tract of the Ovens from about Everton south to Bright. Around Albury they occupy the low ridge crests and bench situations on the higher hills. They are formed on a variety of parent materials but in the valley landscapes most usually on colluvium and alluvium.

Two main forms are readily recognised. One has earthy ped fabric and only moderately well developed structure in the B-horizon; the other has smooth ped fabric and strong fine pedality in the B-horizon. The former occurs on the terrace remnant just below the extensive high terrace-valley plain in the Ovens valley and on alluvial fans and valley fills (of presumably similar age) in the landscape. Those with the more strongly developed B-horizon are common on older land forms and are often found to have stone lines in the A-horizons or at the A-B boundary. Pedal red clay, similar to that of this later form, is often found as a truncated relict, buried under massive gradational soils or other weakly differentiated soils.

The most characteristic feature of the group, which is shared by both forms, is the contrast in colour and texture between the A and B horizons. Surface soils are typically dark greyish brown loam to sandy loam with a paler, often well bleached A2-horizon. The B-horizons are reddish brown, yellowish red or red clay. Mottled reddish brown and yellowish red B-horizons also occur.

These are all acid soils, although in some the reaction trend is towards neutral in the B-horizon. They are generally only moderately fertile and would show good responses to superphosphate.

The red podzolic soils (Rowe 1967, 1972, Crouch & Junor 1976) and the Randelong and Buffalo Series of Newell (1970) are included in the group.

3.2 Calcareous Reddish Duplex Soils. These occur in the north west of the area where they are relatively widespread: for example around Howlong and to the north of Wangaratta. They are found on old alluvium which forms a high terrace adjacent to the trunk streams, or on ridges of the prior-stream systems in these areas.

Soils of this group have a dark reddish brown loam or fine sandy loam A1-horizon which may be apedal and hard-setting or weakly structured, and a paler or bleached A2-horizon. There is an abrupt

change at about 15 to 30 cm to a red, reddish brown or yellow red clay B-horizon which has well developed subangular-blocky to blocky structure. Free lime occurs in the B-horizon. These soils are usually quite deep. The group includes the red brown earths and solonized red brown earths of Crouch and Junor (1976) and the Tara Series of Newell (1970).

3.3 Yellowish Duplex Soils. These soils occur generally in areas where drainage is impeded. Two main forms are recognized. In both the characterizing contrast between the A- and B-horizons is usually from loam, sandy loam or silty clay loam to medium to heavy clay. The colours vary from dark greyish brown in the A1-horizon through a paler, usually well bleached A2-horizon to the yellowish brown to olive brown whole coloured or mottled B-horizon. The A-horizons typically lack structure and are hard setting, but the B-horizons have moderate to well developed blocky to sub-angular blocky structure.

The main occurrences of the more extensive form of yellowish duplex soils are on old alluvium which forms the poorly drained extensive high terrace — valley plains to the north and west of Albury, around Bandiana — Bonegilla and around Wangaratta. They have a relatively thick well developed reddish yellow B-horizon with a distinct contrast between the upper and lower parts. The lower B-horizon has abundant soft ironstone segregations and the zone between the two parts may be somewhat bleached and have pisolitic ironstone. This soil is regarded by van Dijk and Rowe (in preparation) as a valuable soil-stratigraphic marker which typifies the Mudgeegonga pedo-morpholith.

In general, surface pH is acid but subsoil reactions are commonly less acid to around neutral. The group is considered to be of low to moderate fertility and suffers from impeded drainage.

The other less widespread form has a shallower profile and is found mainly on younger valley fills. It has a less well structured B-horizon and occasionally free lime is present in the lower B-horizon.

The yellow duplex soils with acid subsoils and those with alkaline subsoils (Rowe 1972) and the yellow solonetzic soils of Crouch and Junor (1976) are included in this group.

CONCLUSIONS

The area described is the transition zone between the Eastern Highlands and the Riverine Plain to the west. Massive dissection of old landscapes, extensive surface stripping of valley slopes and sedimentation of valley bottoms have all occurred within this area in the past. In more recent times the magnitude of the erosion and deposition have waned, but their effects are widespread.

Factors which have influenced the relative proportions of the surficial bodies of differing age, and therefore of the soils, include slope angle and length, configuration of the slopes, position in relation to downcutting or aggrading drainage systems, the nature of the rock and the depth of weathering, the climate, and probably even some element of chance. This means that although some generalizations can be made about the distribution of the main soil groups, description of the detailed patterns is more difficult, and in many situations it is possible to find soils of several ages associated in a more finely detailed version of the regional pattern.

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